

Species Diversity, 2005, **10**, 85–104

The Identity of *Raymunida elegantissima* (Crustacea: Decapoda: Anomura: Galatheidae) and Description of a Closely Related New Species from Japan

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(Received 6 April 2004; Accepted 15 March 2005)

Raymunida elegantissima (de Man, 1902) is redescribed on the basis of the holotype from the Moluccas, Indonesia. A new species of *Raymunida* Macpherson and Machordom, 2000, *R. lineata*, is described and illustrated on the basis of specimens collected from Japan. This species is close to *R. elegantissima*, but is distinguished by the structure of the fifth and sixth thoracic sternites, second to fourth abdominal segments, first segment of the antennal peduncle, and fixed finger of the cheliped. *Raymunida lineata* exhibits variation in the length of the mesial spine of the first antennal segment, which is a character used to divide the genus into two groups in the most recent key to the species of *Raymunida*.

Key Words: Crustacea, Anomura, Galatheidae, *Raymunida*, new species, Japan.

Introduction

The genus *Raymunida* Macpherson and Machordom, 2000 was established for *R. cagnetei* Macpherson and Machordom, 2000 (type species), *Munida bellior* Miyake and Baba, 1967, and *M. elegantissima* de Man, 1902 (Macpherson and Machordom 2000). Macpherson and Machordom (2001) and Lin *et al.* (2004) subsequently recognized five additional new species in the genus: *R. confundens* Macpherson and Machordom, 2001; *R. dextralis* Macpherson and Machordom, 2001; *R. erythrina* Macpherson and Machordom, 2001; *R. formosanus* Lin, Chan, and Chu, 2004; and *R. insulata* Macpherson and Machordom, 2001. The genus now includes eight species, all recorded only from the Indo-Pacific region.

Specimens of an unknown galatheid from the Izu Peninsula, central Japan, were forwarded to me for identification by Mr. Ryo Minemizu, a well-known Japanese underwater photographer. These specimens agreed well in coloration with *R. elegantissima* (or *Munida elegantissima*) as shown by Baba (1969), Kato and Okuno (2001), and Minemizu (2002). Morphological examination of Japanese specimens including those reported by Baba (1969) and Kato and Okuno (2001) showed that these specimens, except for one specimen by Baba (1969), are conspecific. Macpherson and Machordom (2001) defined the morphological and color characters of *R. elegantissima* based on the specimens available to them; however, re-examination of the holotype of this species revealed that it does not fully agree with

their diagnosis. The Japanese specimens resemble more the holotype of *R. elegantissima* than the material of Macpherson and Machordom (2001), but differ from both in some characters. Here I describe and illustrate the Japanese specimens as a new species of the genus *Raymunida*. *Raymunida elegantissima* is also re-described on the basis of its holotype.

Postorbital carapace length (cl), the indication of specimen size in “Material examined” of each species, is measured from the level of the sinus formed by the rostrum and supraocular spines to the posterior margin along the midline. Segment lengths of chelipeds are measured along the dorsomesial margin, and those of walking legs, along the extensor margin. The general terminology followed is that used by Baba and de Saint Laurent (1996). The posterior transverse ridge on each abdominal segment is treated as the “main transverse stria”, in accordance with the terminology of Macpherson and Machordom (2000, 2001). The type specimens of the new species are deposited in the National Science Museum, Tokyo (NSMT), Coastal Branch of Natural History Museum and Institute, Chiba (CMNH), and Zoological Laboratory, Faculty of Agriculture, Kyushu University (ZLKU, now housed in the Kitakyushu Museum of Natural History and Human History). The holotype of *Raymunida elegantissima* is housed in the Forschungsinstitut Senckenberg, Frankfurt am Main (SMF).

Taxonomy

Raymunida elegantissima (de Man, 1902) (Figs 1, 2)

Munida elegantissima de Man, 1902: 726, pl. 24, figs 42, 42a, 42b.

Raymunida elegantissima: Macpherson and Machordom 2000: 257.

Material examined. Holotype: male (4.4 mm cl), Moluccas, 1894, coll. Kükenthal, SMF 4639.

Redescription. Carapace (Fig. 1A) excluding rostrum slightly longer than wide. Dorsal surface slightly convex from side to side; transverse ridges mostly uninterrupted, with dense, short, plumose setae anteriorly, few long, iridescent, simple setae also present on anterior gastric region. Intestinal region with short striae. Gastric region with row of 5 pairs of epigastric spines, median and lateral pairs smaller than others. Cervical grooves distinct. One parahepatic spine, 1 branchial anterior spine, and 1 postcervical spine present on each side. Frontal margins slightly oblique, with small spine between supraocular and anterolateral spines. Suborbital margins with denticles. Anterolateral spines situated slightly mesial to anterolateral angle of carapace, moderately well-developed but not reaching level of sinus between rostrum and supraocular spines. Second lateral marginal spine situated in front of cervical groove, smaller than preceding spine. Branchial margins slightly convex, each with 4 spines, posterior spine smaller than others. Another small spine ventral to level of second lateral marginal spine.

Rostrum (Fig. 1A) spiniform, approximately half length of remaining carapace, slightly arched; lateral margins minutely crenulate distally. Supraocular spines moderately long, overreaching midlength of rostrum, slightly divergent an-

teriorly, nearly horizontal.

Pterygostomian flaps (Fig. 1B) unarmed but with small tubercles on anterior dorsal margin; lateral surface with oblique and longitudinal ridges of various length.

Sternal plastron (Fig. 1C) depressed along midline. Third thoracic sternite 4.2 times as wide as long (measured along midline); anterior margin with median notch and very small spine at each lateral angle; lateral margins nearly parallel, slightly convex. Fourth sternite 3.3 times as long as preceding sternite (measured along midline), with 2 transverse, moderately long, granulate striae, anterior stria interrupted medially; anterior margin subequal in width to third sternite, slightly concave. Fifth and sixth sternites each with pair of faint, short striae on lateral parts. Seventh sternite smooth. Transverse ridges of fifth to seventh sternites obtuse, feebly granulate.

Abdominal segments (Fig. 1D) with dense, short, plumose setae on anterior margins of transverse ridges and striae; ridges also with scattered long, iridescent, simple setae but otherwise unarmed, somewhat elevated, uninterrupted on second to fourth segments but interrupted in median part on fifth and sixth segments. Second to fourth segments with main, continuous transverse stria preceded by faint, short striae on median and lateral parts. Fifth and sixth segments only with main transverse stria interrupted in median part. Telson weakly calcified, indistinctly divided by shallow sutures; distal margin with broad median notch.

Eyes (Fig. 1A, E) large; corneas very weakly dilated, maximum diameter approximately 0.3 length of distance between mesial bases of anterolateral spines; eyelash of simple setae relatively short; single long, simple seta present near distal margin of rounded dorsal extension of peduncle.

Basal segment of antennular peduncles (Fig. 1E), excluding distal spines, approximately 0.2 length of carapace excluding rostrum, moderately elongate but not overreaching distal margin of corneas; distomesial spine shorter than distolateral; 2 spines present on lateral margin of basal segment, proximal spine short, located on subdistal part of segment, distal spine very long, overreaching distolateral spine.

Antennal peduncles (Fig. 1A, E) moderately short. First segment with moderately long distal spine on mesial margin, this spine reaching distal margin of third segment but not reaching midlength of basal segment of antennular peduncle; distolateral angle unarmed. Second segment with strong spine each at distomesial and distolateral angles, mesial spine slightly longer than lateral one, overreaching distal margin of third segment but not reaching distal margin of fourth segment; mesial margin with small spine. Third segment with small spine at distomesial angle, distolateral margin unarmed (left) or with very small spine (right). Fourth segment unarmed.

Third maxilliped (Fig. 1F) with ischium armed with strong spine at distomesial angle; disto-extensor angle acutely produced. Merus slightly narrowed distally, flexor margin with 2 subequal, strong, slender spines; extensor margin with small distal spine. Carpus with slender spine on distoflexor margin, disto-extensor angle slightly produced. Propodus and dactylus unarmed, relatively slender. Exopod overreaching distal margin of merus.

Epipods present on third maxilliped and first to third pereopods.

Chelipeds (Fig. 2A, B) relatively long, approximately 3.6 times as long as cara-

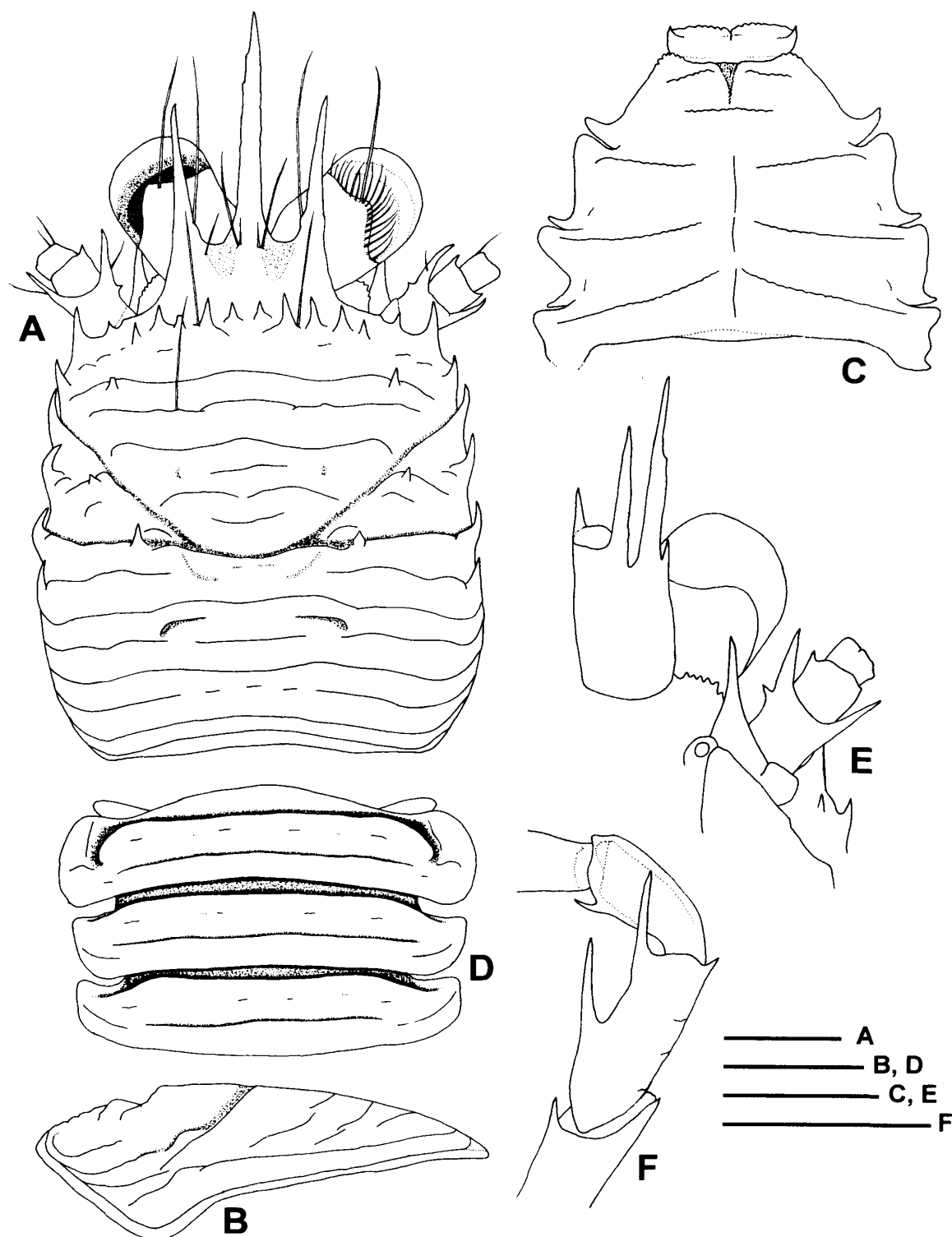


Fig. 1. *Raymunida elegantissima* (de Man, 1902), holotype male (4.4 mm cl, SMF 4639) from Moluccas. A, Carapace and antennal peduncles, dorsal (setae partially omitted); B, left pterygostomian flap, lateral (setae omitted); C, sternal plastron, ventral (setae omitted); D, second to fourth abdominal segments, external (setae omitted); E, left eye, basal segment of antennular peduncle, and antennal peduncle, ventral (setae omitted); F, left third maxilliped, merus and propodus, lateral (setae omitted). Scales: 1.0 mm.

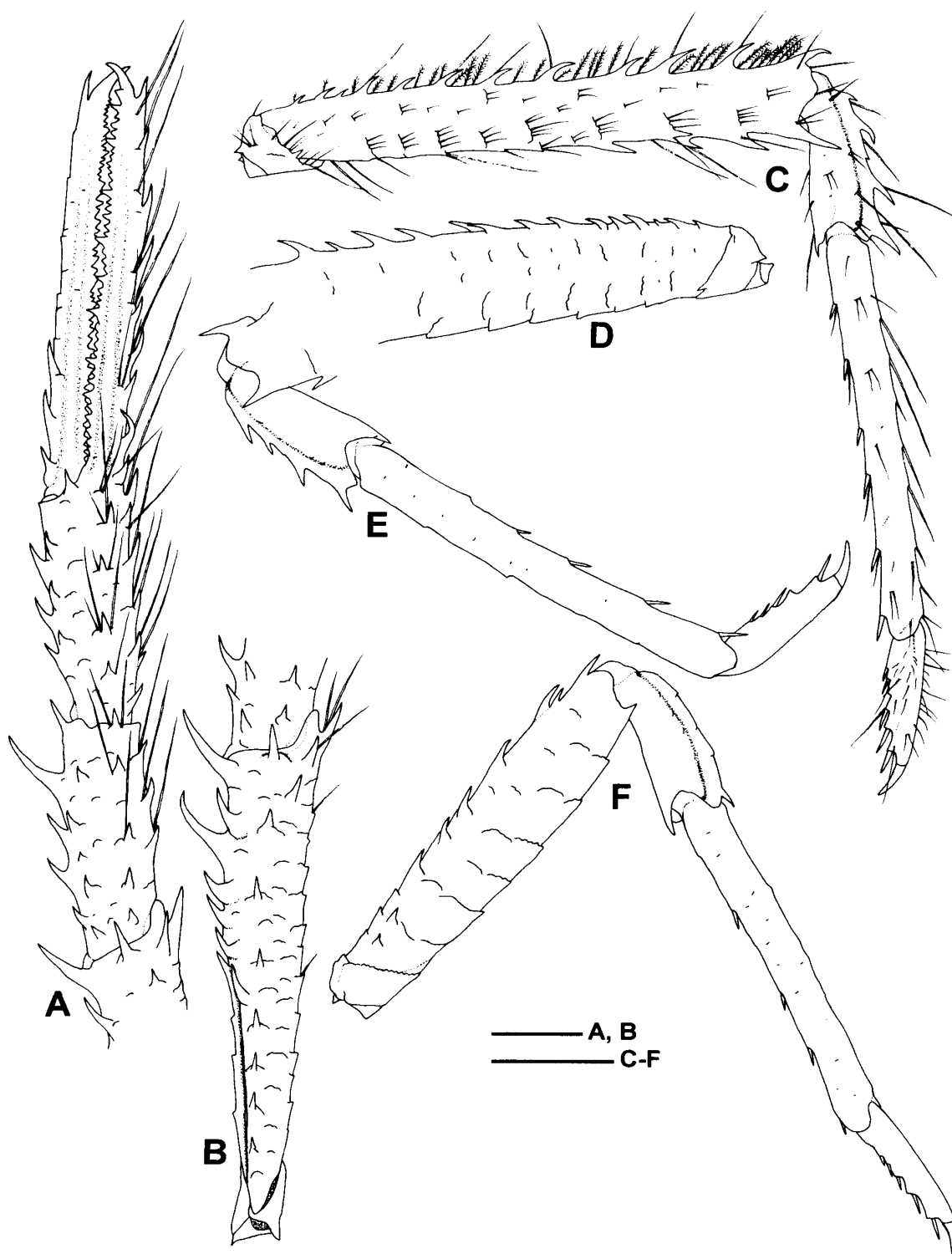


Fig. 2. *Raymunida elegantissima* (de Man, 1902), holotype male (4.4 mm cl, SMF 4639) from Moluccas. A, Right cheliped, carpus and chela, dorsal (setae omitted from mesial surface and opposable margins of fingers); B, same, ischium and merus, dorsal (setae omitted from mesial surface); C, right second pereopod, lateral; D, left third pereopod, ischium and merus, lateral (setae omitted); E, same, carpus, propodus, and dactylus, lateral (setae omitted); F, right fourth pereopod, lateral (setae omitted). Scales: 1.0 mm.

pace excluding rostrum, with short squamiform ridges except on fingers and numerous iridescent, long, simple setae and regular or irregular longitudinal rows of spines; ridges anteriorly bearing short, plumose setae. Carpus 1.1–1.2 times as long as palm. Chela slender, 7.5–7.8 times longer than width measured at bases of fingers. Palm 2.6–2.7 times as long as wide and 0.5 times as long as dactylus; dorsolateral margin with row of spines continuing along entire fixed finger; ventrolateral margin with row of small spines; mesial surface with median row of spines; ventromesial margin with few small spines; ventral surface slightly inflated, unarmed. Fingers slender, slightly arched ventrally, distally curving and crossing when closed, ending in sharp point, each with subdistal spine; dorsal and ventral surfaces each with longitudinal rounded crest on midline; opposable margins slightly gaping, each with row of numerous irregular-sized, small, subacute teeth. Dactylus with 3 small spines on proximal 0.3 of slightly crenulated dorsomesial margin; ventromesial margin unarmed.

Walking legs (Fig. 2C–F) relatively long, slender, with scattered short and long, iridescent, simple setae. Second pereopod 2.4 times as long as carapace excluding rostrum; merus more slender and longer than those of third and fourth pereopods, approximately 8.4 times as long as height at midlength, approximately 3.0 and 1.4 times longer than carpus and propodus, respectively; propodus approximately 10.0 times as long as height at midlength, approximately 2.1 times longer than dactylus. Left third pereopod (right missing) with merus broken in distal part. Right fourth pereopod (left missing) shorter than second pereopod; merus approximately 0.7 length of that of second pereopod, approximately 4.1 times as long as height at midlength; merocarpal articulation nearly reaching frontal margin of carapace. Ischium with small spine near flexor angle of lateral distal margin in second and third pereopods but unarmed in fourth pereopod, mesial distal margin unarmed in second pereopod but with small spine near extensor angle in third and fourth pereopods. Merus with extensor margin bearing row of short, plumose setae, and spines increasing in size distally, spines arranging in irregular single (second pereopod) or partial double (third and fourth pereopods) row; lateral surface with transverse squamiform ridges bearing short, plumose setae and few to some long, simple setae, additional short row of spines present near proximal extensor margin in fourth pereopod only; lateral flexor margin crenulated, with 5 spines (including 1 submarginal spine) on distal half of second pereopod and 1 distal spine on fourth pereopod; mesial flexor margin with subdistal spine in second pereopod but unarmed in fourth pereopod. Carpus with 3 strong and 2 small spines (second pereopod), 3 strong and 1 small spines (third pereopod), or 1 distal strong spine (fourth pereopod) on extensor margin; distoflexor margin produced, terminating in small spine; lateral surface unarmed but with somewhat elevated longitudinal crest along extensor margin and few short, oblique, squamiform ridges on flexor half. Propodus unarmed but slightly crenulate on extensor margin; lateral surface with few short, transverse ridges; flexor margin with 7 (second pereopod), 6 (third pereopod), or 5 (fourth pereopod) slender, corneous spines including distal pair, distolateral spine larger than distomesial one (latter not illustrated). Dactylus slender, with slightly curved distal claw; extensor margin weakly convex or nearly straight; flexor margin with 6 (second pereopod) or 5 (third and fourth pereopods) slender, corneous spines decreasing in size proximally, each spine arising from low process.

Pair of pleopods modified as gonopods present on first and second abdominal segments, second pair more developed than first. Pleopods on third to fifth abdominal segments flattened, spatulate.

Distribution. Presently known with certainty only from the type locality, Moluccas (Maluku), Indonesia.

Remarks. The holotype of *Raymunida elegantissima* lacks the right third and left fourth pereopods, and the left second and third pereopods are partially broken. The type specimen is small (4.4 mm cl), but it possesses well-developed first and second gonopods as well as clearly opened male gonopores on the coxae of the fifth pereopods.

Without re-examining the holotype of *R. elegantissima*, Macpherson and Machordom (2001) defined the morphological and color characters of the species based on available specimens and reported the certain distribution of this species as spanning the Malay Archipelago, Philippines, New Caledonia, Chesterfield Islands, Bellona Island, Futuna Island, Vanuatu, and Fiji, at depths of 50 to 194 m. *Raymunida elegantissima* (as *Munida elegantissima*) has also been recorded from Amirantes and Providence Islands (western Indian Ocean), Zanzibar, the Gulf of Mannar, the Andaman Sea, the Seram Sea, western and eastern Australia, and Japan (Southwell 1906, as *Munida alcocki* Southwell, 1906; Laurie 1926; Tirmizi 1966; Baba 1969, 1977, 1989; Haig 1973; Tirmizi and Javed 1993). The specific identity of these specimens requires confirmation since most were not taken into consideration in the revision of the species of *Raymunida* by Macpherson and Machordom (2001).

Macpherson and Machordom (2001) mentioned that the specimen from Zanzibar reported by Tirmizi (1966) had the first antennal segment with a mesial spine not reaching the distal margin of the basal segment of the antennular peduncle and the merus of the third maxilliped bearing a spine on the disto-extensor margin. These two features could assign the specimen to either *R. elegantissima* or *R. cagnetiei*; however, precise specific identification was impossible since the specimen was damaged (see Macpherson and Machordom 2001).

Ahyong and Poore (2004) re-examined the specimen from Western Australia reported by Haig (1973). Although the specimen was badly fragmented, it agreed with the diagnosis of *R. elegantissima* proposed by Macpherson and Machordom (2001).

The holotype of *R. elegantissima* does not fully agree with this diagnosis, however. In the holotype, the second and third abdominal segments have the main transverse stria preceded by faint, short striae on the median and lateral parts, whereas in Macpherson and Machordom's (2001) material, the main transverse stria is described as being preceded by a continuous stria or interrupted striae. In the holotype, the second segment of the antennal peduncle has a small spine on the mesial margin and its third segment also bears a small spine on the distomesial margin, but those spines are diagnosed or illustrated as lacking in the material of Macpherson and Machordom (2001, fig. 1F). In addition to these differences, the mesial spine of the first segment of the antennal peduncle is much shorter in the holotype than in Macpherson and Machordom's (2001) specimens. In the holotype, the spine reaches the distal margin of the third antennal segment but not the mid-length of the basal segment of the antennular peduncle. In Macpherson and Machordom's (2001) specimens, in contrast, the spine slightly overreaches the fourth

antennal segment and nearly reaches the distal margin of the antennular basal segment. These discrepancies indicate that Macpherson and Machordom's (2001) specimens of *R. elegantissima* at least partly do not represent the true species and could be assigned to a different, undescribed species. Thus, re-examination of the specimens hitherto identified as *R. elegantissima* is still strongly needed.

***Raymunida lineata* sp. nov.**

(Figs 3–6)

Munida elegantissima: Baba 1969: 37 (part), figs 3, 4; 1989: 131. [Not *Munida elegantissima* de Man, 1902]

Munida japonica: Miyake 1983: 110, unnumbered fig., 266 (part); Takeda 1994: 230 (part), fig. 2; Minemizu 2000: 168 (part), unnumbered figs. [Not *Munida japonica* Stimpson, 1858]

Galathea sp. 1: Gosliner *et al.* 1996: 226, fig. 821.

Raymunida elegantissima: Kato and Okuno 2001: 89 (part), 147, unnumbered figs; Minemizu 2002: 168 (part), unnumbered figs. [Not *Raymunida elegantissima* (de Man, 1902)]

? *Munida elegantissima*: Tirmizi and Javed 1993: 93, fig. 40.

Type series. Holotype: female (11.5 mm cl), NSMT-Cr 15771, Ose-zaki, Izu Peninsula, Shizuoka Prefecture, 20 m, 1 March 2002, coll. R. Minemizu. Paratypes: 1 female (10.2 mm cl), NSMT-Cr 15772, same data as holotype; 1 male (11.5 mm cl), CMNH-ZC 1029, Ashika-ne, off Kamogawa, Boso Peninsula, Chiba Prefecture, 10 m, 14 September 2002, coll. H. Kawase and K. Yanagi; 1 female (7.3 mm cl), CMNH-ZC 466, Hachijo-jima Island, Izu Islands, detail collection site not recorded, 14 July 1999, coll. S. Kato; 1 ovigerous female (8.5 mm cl), CMNH-ZC 467, Nazumado, Hachijo-jima Island, Izu Islands, 25 m, 1 December 2000, coll. S. Kato; 1 female (7.3 mm cl), NSMT-Cr 15773, Nakanomama, Hachijo-jima Island, Izu Islands, 20 m, May 2003, coll. T. Matsukawa; 1 male (6.9 mm cl) and 1 ovigerous female (7.5 mm cl), ZLKU 12454, off Mage-jima Islet, off Tanega-shima Island, Osumi Islands, 35–40 m, 30 June 1968, coll. Kagoshima University.

Description. Carapace (Fig. 3A) excluding rostrum slightly longer than wide. Dorsal surface moderately convex from side to side; transverse ridges mostly uninterrupted, with dense, very short, plumose setae anteriorly, several short and long, iridescent, simple setae also present. Intestinal region with short striae. Gastric region usually with row of 5 pairs of subequal epigastric spines (11 spines in paratype, NSMT-Cr 15772). Cervical grooves distinct. One parahepatic spine, 1 or 2 branchial anterior spines (spine near anterior end sometimes replaced by small tubercle or absent), and 1 postcervical spine present on each side. Frontal margins slightly oblique, with small spine between supraocular and anterolateral spines. Suborbital margins with denticles. Anterolateral spines each situated slightly mesial to anterolateral angle of carapace, moderately well-developed but not reaching level of sinus between rostrum and supraocular spines. Second lateral marginal spine situated in front of cervical groove, distinctly smaller than preceding spine. Branchial margins slightly to moderately convex, each with 4 spines decreasing in size posteriorly. Another small spine ventral to level of second lateral

marginal spine.

Rostrum (Fig. 3A) spiniform, 0.4–0.5 times as long as remaining carapace, horizontal or slightly arched; lateral margins minutely crenulate distally. Supraocular spines moderately long, reaching half length of rostrum, subparallel, slightly directed upward.

Pterygostomian flaps (Fig. 3B) unarmed but with very small tubercles or denticles on anterior dorsal margin; lateral surface with oblique and longitudinal ridges of various length.

Sternal plastron (Fig. 3C) depressed along midline. Third thoracic sternite 3.2–4.3 times as wide as long (measured along midline); anterior margin with distinct median notch and small spine at each lateral angle; lateral margins nearly parallel; posterior margin touching anterior margin of fourth sternite, or somewhat separated from that margin and oblique. Fourth sternite 2.3–2.9 times as long as preceding sternite (measured along midline), with 2 transverse long, granulate striae, anterior stria interrupted medially; anterior margin concave, slightly narrower than third sternite. Fifth and sixth sternites with pair of oblique striae on lateral parts, striae on sixth sternite shorter than those of fifth sternite. Seventh sternite smooth. Transverse ridges of fifth to seventh sternites obtuse, feebly granulate.

Abdominal segments (Fig. 3D, E) with dense, very short, plumose setae on anterior margins of transverse ridges and striae; ridges also with scattered short and long, iridescent, simple setae but otherwise unarmed, somewhat elevated, uninterrupted on second to fifth segments (ridge on fifth segment shorter than those on preceding segments) but interrupted in median part on sixth segment. Second and third segments with main, continuous transverse stria preceded by median long stria (rarely interrupted in median part of third segment). Fourth segment with main, continuous transverse stria preceded by pair of median, moderately long striae or by transverse row of several short striae. Fifth and sixth segments only with main transverse stria, this uninterrupted (fifth segment) or interrupted in median part (sixth segment). Telson weakly calcified, indistinctly divided by shallow sutures, and with small, calcified plates and squamiform ridges on distal 0.7; distal margin with broad median notch.

Eyes (Figs 3A, 4A) moderately large; corneas slightly dilated, maximum diameter approximately 0.2 length of distance between mesial bases of anterolateral spines; eyelash of simple setae relatively short; single long, simple seta present near distal margin of rounded dorsal extension of peduncle.

Basal segment of antennular peduncles (Fig. 4A, B), excluding distal spines, approximately 0.2 length of carapace excluding rostrum, elongated but not overreaching distal margin of corneas; distomesial spine shorter than distolateral one; 2 spines present on lateral margin, proximal spine short, located on subdistal part of segment, distal spine very long, overreaching distolateral spine.

Antennal peduncles (Fig. 4A, B) moderately short. First segment with long distal spine on mesial margin, overreaching distal margin of fourth segment and reaching or not reaching distal margin of basal segment of antennular peduncle; distolateral angle unarmed but with granules. Second segment with 1 strong spine each at distomesial and distolateral angles; mesial spine slightly longer than lateral one, reaching distal margin of fourth segment; mesial margin with slender spine. Third segment with small but distinct spine at distomesial angle, distolat-

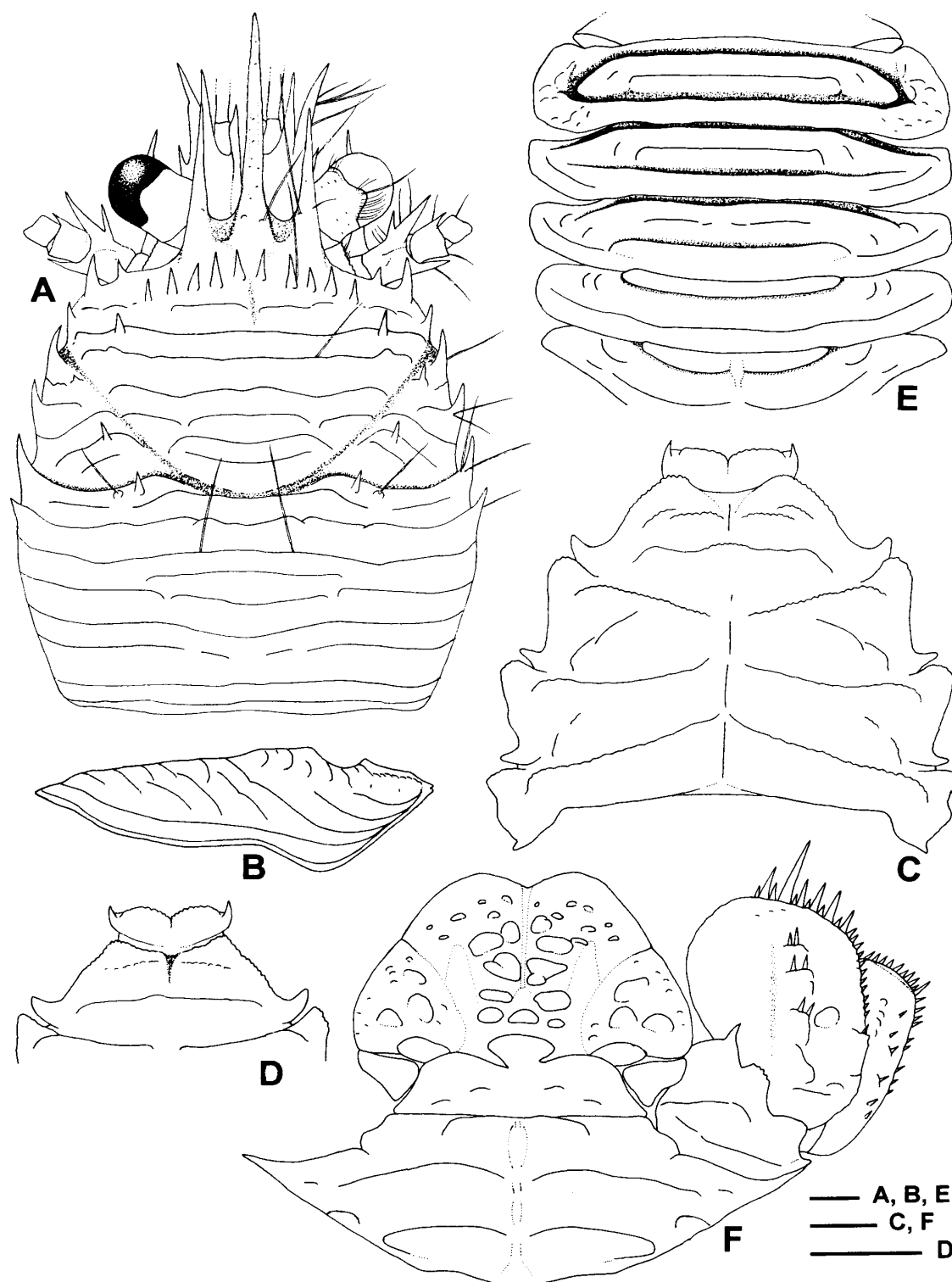


Fig. 3. *Raymunida lineata* sp. nov., holotype female (11.5 mm cl, NSMT-Cr 15771; A–C, E, F) from Izu Peninsula and paratype male (6.9 mm cl, ZLKU 12454; D) from Mage-jima Islet. A, Carapace and cephalic appendages, dorsal (setae partially omitted); B, right pterygostomian flap, lateral (setae omitted); C, sternal plastron, ventral (setae omitted); D, third and fourth thoracic sternites, ventral (setae omitted); E, first to sixth abdominal segments, external (setae omitted); F, sixth abdominal segment and telson, external (setae omitted). Scales: 1.0 mm.

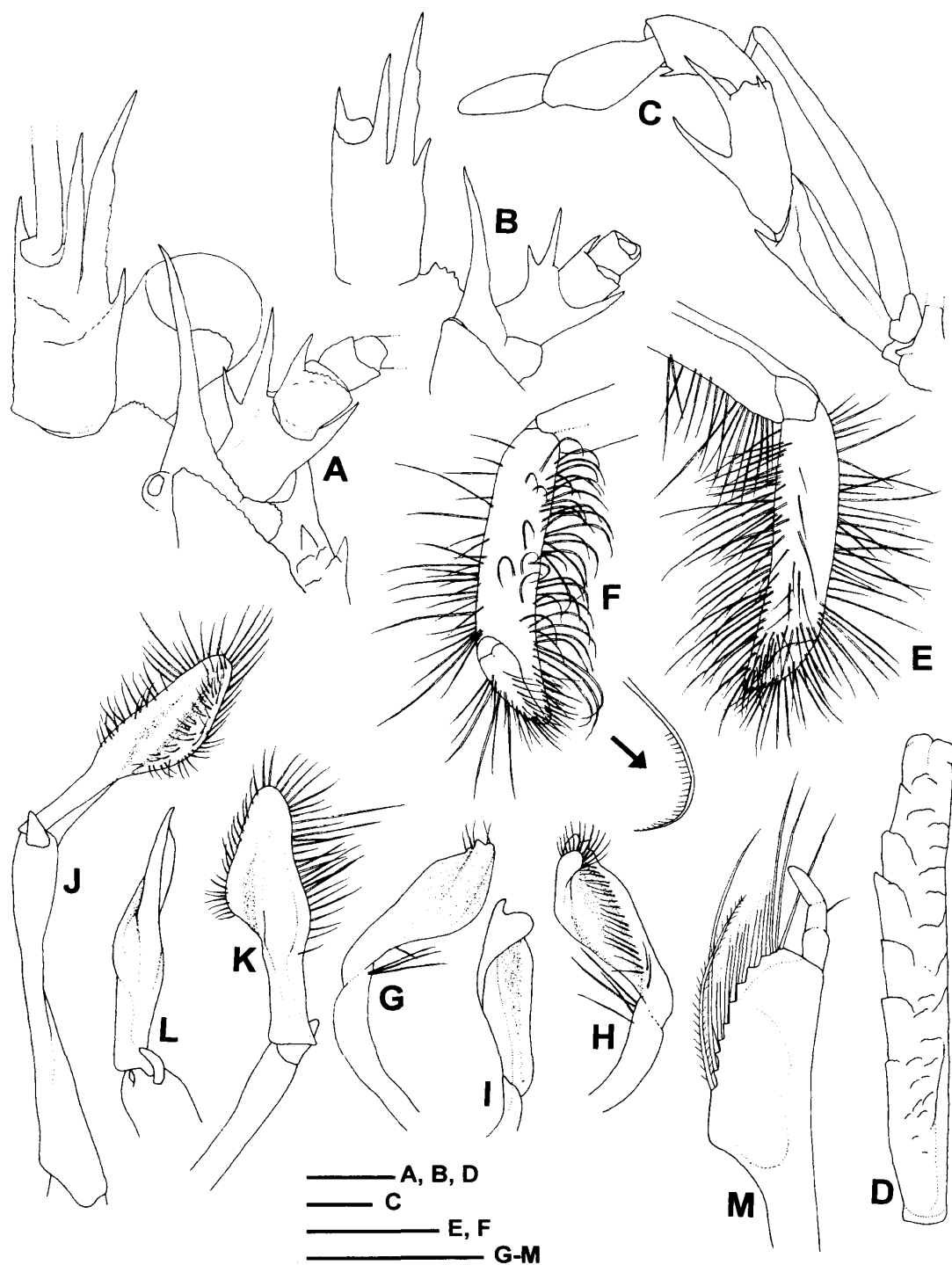


Fig. 4. *Raymunida lineata* sp. nov., holotype female (11.5 mm cl, NSMT-Cr 15771; A, C-F) from Izu Peninsula, paratype ovigerous female (8.5 mm cl, CMNH-ZC 467; B) from Hachijo-jima Island, and paratype male (11.5 mm cl, CMNH-ZC 1029; G-M) from Boso Peninsula. A, B, Left eye, basal segment of antennular peduncle, and antennal peduncle, ventral (setae omitted); C, left third maxilliped, lateral (setae omitted); D, left fifth pereopod, merus, lateral (setae omitted); E, same, dactylus, propodus, and distal part of carpus, ventral; F, same, dorsal (inset: one curved, serrate seta); G, left first pleopod, internal (dorsal), H, same, external (ventral); I, same, lateral; J, left second pleopod, internal (dorsal), K, same, external (ventral); L, same, lateral; M, left third pleopod, external. Scales: 1.0 mm.

eral margin unarmed. Fourth segment unarmed.

Third maxilliped (Fig. 4C) with ischium armed with strong spine at distomesial angle; disto-extensor angle acutely produced, occasionally terminating in spinule. Merus slightly narrowed distally, flexor margin with 2 subequal, strong, slender spines; extensor margin with small distal spine. Carpus with slender spine on distoflexor margin, disto-extensor angle slightly produced. Propodus and dactylus unarmed, relatively slender. Exopod overreaching distal margin of merus.

Epipods present on third maxilliped and first to third pereopods.

Chelipeds (Fig. 5A) relatively long, 2.5–3.4 times as long as carapace excluding rostrum, generally similar in male and female, with numerous short, squamiform ridges except on fingers; ridges anteriorly bearing short, plumose setae; numerous short and long, iridescent, simple setae also present. Merus with somewhat irregular row of small or moderately large spines along mesial and lateral margins of dorsal surface; mesial face with dorsal row of spines increasing in size distally; ventromesial margin with row of spines increasing in size distally; lateral face with few distal spines; ventrolateral margin with row of small spines, distal spine strong; ventral surface unarmed. Carpus approximately as long as palm; dorsal surface with mesial and lateral rows of small spines; mesial surface with row of small spines along midline; ventromesial margin with irregular row of few spines, distal spine largest; lateral surface unarmed; ventrolateral margin with irregular row of few small spines; ventral surface with few spines proximally. Chela slender, 6.2–6.8 times longer than width measured at bases of fingers. Palm 2.2–2.4 times as long as wide and 0.5–0.6 times as long as dactylus (movable finger); dorsal surface with spine at base of movable finger and mesial and lateral rows of spines; dorso-lateral margin with row of spines continuing along proximal 0.6–0.7 of fixed finger, distance between distalmost spine of this row and subdistal spine of fixed finger somewhat varying; ventrolateral margin with row of small spines; mesial surface with median row of spines; ventromesial margin with row of small spines; ventral surface slightly inflated, unarmed. Fingers slender, slightly arched ventrally, distally curving and crossing when closed, ending in sharp point, each with subdistal spine (in CMNH-ZC 1029, 2 subdistal spines on left fixed finger); dorsal and ventral surfaces each with longitudinal rounded crest on midline; opposable margins slightly or somewhat gaping, each with row of numerous irregular-sized, small, subacute teeth. Dactylus (movable finger) with 2–4 small spines on proximal 0.3–0.4 of slightly crenulate dorsomesial margin; ventromesial margin usually unarmed, rarely with small proximal spine.

Walking legs (Fig. 5B–G) relatively long, slender, with scattered short and long, iridescent, simple setae. Second pereopod (first walking leg) 2.2–2.5 times as long as carapace excluding rostrum; merus more slender and longer than those of third and fourth pereopods, 6.2–6.8 times as long as height at midlength, 2.7–2.8 and 1.3–1.4 times longer than carpus and propodus, respectively; propodus 8.5–9.8 times as long as height at midlength, 2.0–2.4 times longer than dactylus. Third pereopod (second walking leg) slightly longer than second pereopod; merus 4.2–4.6 times as long as height at midlength. Fourth pereopod (third walking leg) shorter than second pereopod; merus 0.7 length of that of second pereopod, 3.5–4.2 times as long as height at midlength; merocarpal articulation overreaching level of third lateral spine of carapace (anterior end of cervical groove) but not reaching frontal margin of carapace. Ischium with 1 or 2 small spines near flexor angle of lateral distal mar-

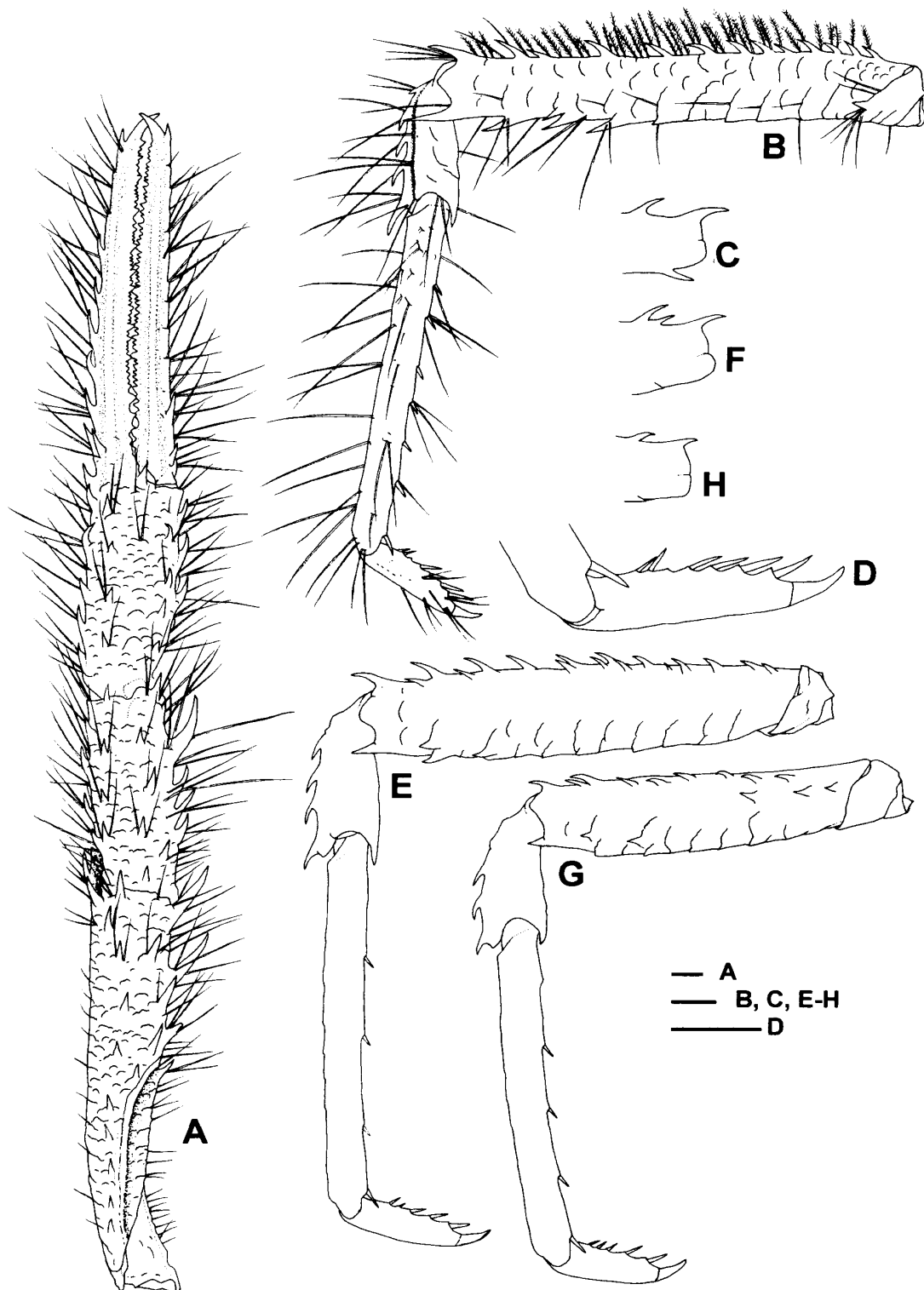


Fig. 5. *Raymunida lineata* sp. nov., holotype female (11.5 mm cl, NSMT-Cr 15771) from Izu Peninsula. A, Left cheliped, dorsal (setae omitted from dorsal surface and opposable margins of fingers); B, left second pereopod, lateral; C, same, distal part of merus, mesial (setae omitted); D, same, dactylus, lateral; E, left third pereopod, lateral (setae and partial squamiform ridges omitted); F, same, distal part of merus, mesial; G, left fourth pereopod, lateral (setae and partial squamiform ridges omitted); H, same, distal part of merus, mesial. Scales: 1.0 mm.

gin in second and third pereopods but unarmed in fourth pereopod, mesial distal margin unarmed in second pereopod but usually with small spine near extensor angle in third and fourth pereopods. Merus with extensor margin bearing row of moderately long, plumose setae and spines increasing in size distally, spines arranging in irregular single row in second pereopod and proximal parts of third and fourth pereopods except for irregular double row on distal 0.6–0.7 in third pereopod and distal half (proximal spines of mesial row very small) in fourth pereopod; lateral surface with transverse, squamiform ridges bearing dense, short, plumose setae and some short or moderately long, simple setae, additional short row of spines present near proximal extensor margin in fourth pereopod only; lateral flexor margin crenulated, with 5 or 6 (second pereopod), 3 or 4 (third pereopod), or 1–3 (fourth pereopod) spines (if present, including submarginal spines) on distal half; mesial flexor margin with 1 or 2 subdistal spines in second pereopod but unarmed or only with small protuberance in third and fourth pereopods. Carpus with 5 (second pereopod), 4 or 5 (third pereopod), or 3 or 4 (fourth pereopod) strong spines on extensor margin; distoflexor margin produced, terminating in small spine; lateral surface unarmed but with somewhat elevated longitudinal crest along extensor margin and few oblique, squamiform ridges on flexor half. Propodus unarmed but slightly crenulate on extensor margin; lateral surface with few short, transverse ridges; flexor margin with 7–9 (second pereopod), 5–8 (third pereopod), or 5 or 6 (fourth pereopod) slender, corneous spines including distal pair, distolateral spine larger than distomesial one (latter not illustrated). Dactylus slender, with slightly curved distal claw; extensor margin weakly convex or nearly straight; flexor margin with 6 or 7 (second pereopod), 5–7 (third pereopod), or 4–6 (fourth pereopod) slender, corneous spines decreasing in size proximally, each spine arising from low process.

Fifth pereopods (Fig. 4D–F) with merus crenulate on flexor margin; carpus with moderately long and dense, simple setae on distal 0.25 and sparse short, simple setae on proximal 0.75 of flexor face; chela elongate, bearing numerous moderately long, simple setae on extensor and flexor faces, setation similar in male and female; palm 2.7 times as long as dactylus, with numerous curved, serrate setae on dorsal flexor face, density of these setae similar in male and female.

Male with pair of pleopods modified as gonopods on first and second abdominal segments, second pair more developed than first. First pleopod (Fig. 4G–I) with dorsally curved, rounded lobe on distomesial margin of distal segment; rounded lobe and lateral margin with short setae; distal margin with 2 small, rounded projections. Second pleopod (Fig. 4J–L) with endopod somewhat twisted, inflated on median part, and bearing short and long setae on distal 0.7 of margins; exopod small, roundly subtriangular. Pleopods on third to fifth abdominal segments (Fig. 4M) flattened, spatulate, with row of plumose setae on lateral margin; short, indistinctly segmented process present on distal margin. Female with pair of elongate pleopods each on second to fifth abdominal segments, those on third to fifth segments well developed.

Uropods (Fig. 3F) with protopods armed with spine on distal lateral margin; proximal lateral margin produced laterally. Endopod broader than exopod, with row of spines and spinules on lateral and distal margins; several spines on distolateral margin large, largest spine clearly overreaching distal margin of telson; ventral surface with longitudinal row of squamiform ridges usually each bearing 1 or

2 small spines. Exopod with row of small spines on lateral and distal margins.

Color in fresh specimens. Ground color of carapace, abdominal segments, chelipeds, and walking legs red or reddish orange (Fig. 6). Carapace with distinct white marks anteriorly along transverse ridges and dark red patches on median parts of epi-, proto-, and mesogastric regions, posterior ends of cervical grooves, mesobranchial regions, and cardiac region; lateral margins and epigastric spines white. Rostrum white along dorsal midline; supraorbital spines with small white stains; base of rostrum and supraorbital spines usually white. Pterygostomian flaps red except for white part along dorsal margin. Second to sixth abdominal segments with dark red spots and white patches on transverse ridges, median parts white in front of transverse ridges; second abdominal segment with pair of lateral white marks. Chelipeds with dark red patches on proximal bases of spines on merus and carpus; several rounded white spots on dorsal and ventral surfaces of palm and ventral surface of carpus; longitudinal light yellow stripe present on dorsal and ventral surfaces of each finger; indistinctly marked, light yellow longitudinal stripe on mesial surface of dactylus; dark red near distal claw of each finger. Walking legs with several rounded white spots on distal parts of lateral and mesial faces of merus and distal part of dorsal face of carpus; longitudinal light yellow stripe on lateral and mesial surfaces of propodus; distal parts of propodus and dactylus dark red and white, respectively.

Distribution. Certain records of the new species are restricted to Japan, namely the Boso and Izu Peninsulas, Hachijo-jima Island in the Izu Islands, and Mage-jima Islet in the Osumi Islands at a depth of 10–40 m.

Gosliner *et al.* (1996, fig. 821) showed a color picture of an unidentified galatheid, *Galathea* sp. 1, from Sulawesi Island, Indonesia. Judging from the color pattern, especially the presence of longitudinal light yellow stripes on the fingers of the chelipeds and propodi of the walking legs, it is referred to *Raymunida lineata*. Thus, the present new species also seems to occur in Indonesian waters.

Etymology. The specific name is derived from the Latin “*lineatus*”, meaning streaked, in reference to the characteristic longitudinal stripes on the fingers of the chelipeds and propodi of the walking legs.

Affinities. *Raymunida lineata* is closest to *R. elegantissima* in sharing the following combination of characters: carapace with some long, simple setae on the dorsal surface; second segment of the antennal peduncle with a small spine on the mesial margin and the third segment also being armed with a small spine on the distomesial margin; merus of the third maxilliped with a small spine on the disto-extensor margin; chelipeds with numerous long, simple setae and slender chela 6.2–7.8 times longer than wide with the palm approximately half the length of the dactylus; and the merocarpal articulation of the fourth pereopod (third walking leg) not reaching the level of the frontal margin of the carapace.

Raymunida lineata, however, is distinguished from *R. elegantissima* by the following characters. The fifth and sixth thoracic sternites have distinctly marked, long, oblique striae on the lateral parts in *R. lineata*, whereas they possess faint, short striae in *R. elegantissima*. The second and third abdominal segments have a main, continuous transverse stria preceded by a median, long stria in *R. lineata*, while they possess faint, short striae on the median and lateral parts in front of the main transverse stria in *R. elegantissima*. The fourth abdominal segment has a main, continuous transverse stria preceded by a pair of median, moderately long



Fig. 6. *Raymumida lineata* sp. nov., entire animal, dorsal. Left, paratype male (11.5 mm cl, CMNH-ZC 1029) from Boso Peninsula (right cheliped missing); right, paratype female (7.3 mm cl, NSMT-Cr 15773) from Hachijo-jima Island (right third pereopod missing). Photographed by J. Okuno.

striae or by a transverse row of short striae in *R. lineata*, whereas it possesses few, faint and short striae in front of the main transverse stria in *R. elegantissima*. The mesial spine on the first segment of the antennal peduncle overreaches the distal margin of the fourth segment in *R. lineata*, but it reaches only the distal margin of the third segment in *R. elegantissima*. The palm of the cheliped bears a row of dorsolateral spines continuing onto the proximal 0.6–0.7 of the fixed finger in *R. lineata*, but the row of spines continues along the entire dorsolateral margin of the fixed finger in *R. elegantissima*. Among these differences, the length and distinctness of the striae on the thoracic sternites and abdominal segments show intraspecific variation to some extent.

Besides *R. lineata* and *R. elegantissima*, *R. cagnetei* and *R. erythrina* also have a small spine on the mesial margin of the second antennal segment (see Macpherson and Machordom 2000, fig. 1C, 2001, fig. 4C). *Raymunida erythrina* is readily distinguished from the other three species by the merus of the third maxilliped being unarmed on the extensor margin (versus with a small disto-extensor spine) and the merocarpal articulation of the fourth pereopod clearly overreaching the level of the frontal margin of the carapace (versus not reaching the level of the frontal margin of the carapace). *Raymunida cagnetei* differs from *R. lineata* and *R. elegantissima* in the third segment of the antennal peduncle being unarmed on the mesial margin (versus having a small distomesial spine), the palm of cheliped being slightly less than two-thirds the length of the dactylus (versus approximately half the length of the dactylus), and the merocarpal articulation of the fourth pereopod reaching only the level of the third lateral (first branchial) spine of the carapace (versus overreaching the level of this spine).

Remarks. Macpherson and Machordom (2001) divided seven *Raymunida* species into two groups based on the length of the mesial spine of the first segment of the antennal peduncle. They mentioned that the importance of this character is supported by mitochondrial cytochrome oxidase subunit I (COI) sequence data. However, Machordom and Macpherson (2004) subsequently mentioned that the relative length of the antennal spine is not always of phylogenetic value according to their molecular and morphological analyses on the species of *Munida* and related genera. *Raymunida lineata* shows variation in the length of the mesial spine of the first antennal segment; i.e., the spine reaches or does not reach the distal margin of the basal segment of the antennular peduncle. Thus, this character should be used with caution in species identification. Among other useful specific characters enumerated by Macpherson and Machordom (2001), the presence of a small spine on the disto-extensor margin of the merus of the third maxilliped links *R. lineata* to *R. cagnetei* and *R. elegantissima*. These two known species and *R. erythrina* belonged to a group characterized by the mesial spine of the first antennal segment never reaching the distal margin of the antennular basal segment. However, the present study revealed that the material of *R. elegantissima* diagnosed by Macpherson and Machordom (2001) is not of the true species, although their material resembles the holotype of the species in the characters of the first antennal segment and merus of the third maxilliped. The assemblage of *R. cagnetei*, *R. elegantissima* sensu lato, *R. lineata*, and *R. erythrina* might be linked together and differentiated from the other species of *Raymunida* by the presence of short or long striae in front of the main, continuous transverse stria on the second abdominal segment.

Baba (1969) recorded *Munida elegantissima* from Miyake-jima Island in the Izu

Islands at the depth of 85 m and Mage-jima Islet (west of Tanega-shima Island) in the Osumi Islands at a depth of 35–40 m. Re-examination of his material disclosed that the specimens from Mage-jima Islet (one male 6.9 mm cl and one ovigerous female 7.5 mm cl, ZLKU 12454) agree well with the other examined specimens of *R. lineata* in morphology, but the specimen from Miyake-jima Island (one female 5.6 mm cl, ZLKU 14346, off Akabakke, Miyake-jima Island, Izu Islands, 85 m, 28 September 1962, coll Y. Kurata) cannot be referred to the new species. Figures 3 and 4 and the color note provided by Baba (1969) are based on the specimens from Mage-jima Islet. The specimen from Miyake-jima Island is now in dry condition with the fixed finger of the left cheliped broken distally, and it lacks the right cheliped and left first walking leg. Despite the poor condition of the specimen, it clearly differs from *R. lineata* and *R. elegantissima* in having no spine on the mesial margin of the second segment of the antennal peduncle. The presence of a small spine on the distomesial margin of the third antennal segment also distinguishes this specimen from the other known *Raymunida* species. The specimen evidently belongs to an undescribed species of *Raymunida*, but is in too poor condition to serve as type.

Specimens in color photographs identified by Miyake (1983), Takeda (1994), and Minemizu (2000) as *Munida japonica*, by Gosliner *et al.* (1996) as *Galathea* sp. 1, and by Kato and Okuno (2001) and Minemizu (2002) as *Raymunida elegantissima* can be referred to *Raymunida lineata*. They all have the color pattern characteristic of *R. lineata*.

Baba (1989) recorded *Munida elegantissima* from Amami-oshima Island in the Ryukyu Islands, southwestern Japan, at a depth of 40 m. He mentioned (p. 131) that “the color of the living specimen is as noted by Baba (1969: 40).” Although the specimen was not available for the present study, it can be assigned to *R. lineata* based on the characteristic color pattern.

Tirmizi and Javed (1993) reported *Munida elegantissima* from the Andaman Sea in the eastern Indian Ocean, at a depth of 77 m, and a small spine on the distomesial margin of the third segment of the antennal peduncle is illustrated (fig. 40E). This spine is assumed at present to be a character peculiar to *R. lineata* and *R. elegantissima* *sensu stricto*. Between these two species, Tirmizi and Javed’s (1993) material seems to be more closely allied to *R. lineata* in having the second abdominal segment with moderately long, distinct striae in front of the main, continuous transverse stria, and the first segment of the antennal peduncle with a mesial spine overreaching the distal margin of the fourth segment (their fig. 40A, E). However, re-examination of Tirmizi and Javed’s (1993) specimens is needed to confirm its identity. The reference is included only questionably in the synonymy of *R. lineata*.

It is noteworthy that the length of the mesial spine on the first segment of the antennal peduncle differs between the specimens from the Izu and Boso Peninsulas on the one hand, and those from Hachijo-jima Island in the Izu Islands and Mage-jima Islet in the Osumi Islands on the other. The spine reaches or slightly overreaches the distal margin of the basal segment of the antennular peduncle in the former specimens, whereas it does not reach the distal margin in the latter ones. These specimens agree well with each other in the other morphological characters and color pattern (see Fig. 6), and they almost certainly belong to the same species.

Acknowledgements

I thank S. Kato, H. Kawase, T. Matsukawa, R. Minemizu, and K. Yanagi for collecting the specimens examined in this study. I am also grateful to J. Okuno of the Coastal Branch of Natural History Museum and Institute, Chiba, M. Shimomura of the Kitakyushu Museum of Natural History and Human History, and M. Türkay and A. Allspach of the Forschungsinstitut Senckenberg for arranging loans of the specimens of the new species and the holotype of *Raymunida elegantissima* deposited in their museums. Junji Okuno also kindly provided me with his color photographs for publication. I gratefully acknowledge K. Baba of Kumamoto University, E. Macpherson of the Centro de Estudios Avanzados de Blanes (CSIC), and S. T. Ah Yong of the Australian Museum for their constructive comments on the manuscript. This study was supported in part by a grant from the Research Institute of Marine Invertebrates.

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